CHAPTER 3

DIESEL ENGINES

3-1. Minimum maintenance activities for diesel engines

The tables located at the end of this chapter indicate items that must be performed to maintain the diesel engines at a minimum level of operational readiness. Due to the many variations in engine age and design that may be encountered, not all of the items listed will be applicable for all facilities. All maintenance must be performed in accordance with the engine manufacturer's published maintenance schedule and procedures for the specific engine installed. Maintenance actions are included in this chapter for various modes of operation, subsystems, or components. Table 3-1 provides maintenance information for diesel engines in standby mode. Table 3-2 provides maintenance information for diesel engines operating in short-term activities. Short-term activities are those scheduled maintenance activities with a frequency of 1,000 hours run time or less. Table 3-3 provides maintenance information for diesel engines operation in long term activities. Long-term activities are those scheduled maintenance activities with a frequency greater than 1,000 hours run time.

3-2. Major equipment maintenance for diesel engines

Any maintenance procedure that requires disassembly of the engine or removal of components is considered major maintenance. Personnel performing any of the major maintenance procedures listed in this chapter must be trained diesel engine mechanics. In addition, the timing of the maintenance schedule for major maintenance items can vary significantly based on the engine design and speed. All maintenance must be performed in accordance with the engine manufacturer's published maintenance schedule and procedures for the specific engine installed.

3-3. Diesel engine performance trend analysis

Trend analysis is a valuable tool in predicting maintenance requirements and shall be used to determine impending problems and to schedule maintenance. Trend analysis consists of recording significant operating data and plotting that data versus engine hours and then analyzing the graphs for significant changes in performance. Operating data should be obtained under the same load and general operating conditions each time it is recorded. Data shall be taken at intervals not to exceed 250 hours (100 hours is preferred). Any significant change in recorded data should be verified by obtaining a second set of data. Various commercial software packages are available to aid in the planning of maintenance and analysis of malfunctions. These systems use field instrumentation to constantly monitor the status of the engine health. By storing this monitored data in a database during periods of normal operation, the system can identify changes in the operating behavior of the engine over long periods of time. Necessary adjustments and maintenance work can thus be planned on the basis of the engine condition. As a minimum, the following data shall be obtained and plotted.

a. Cylinder compression pressures

b. Cylinder firing pressures

c. Fuel pump/injector rack or governor power piston position

d. Cylinder exhaust temperature

e. Crankcase pressure (or vacuum)

f. Lube oil pressure at engine inlet or header

g. Air inlet manifold pressure

h. Lube oil added to engine sump in the last 100 hours. Do not include oil changes.

i. Lube oil analysis results, especially for trace metals

Table 3-1. Diesel engine – standby mode

Diesel Engine – Standby Mode	
Action	***Frequency***
WARNING! THE MAINTENANCE PROCEDURES OUTLINED IN THIS SECTION MAY OR MAY NOT REQUIRE REMOVING AN ENGINE FROM ITS READY STANDBY STATE SO THAT THE ENGINE DOES NOT AUTOMATICALLY START IF A POWER FAILURE OCCURS. WHEN NECESSARY, OBTAIN CLEARANCE FROM OPERATOR AND VERIFY THAT CONTROLS AND ENGINE STARTING DEVICES ARE PROPERLY LOCKED OUT TO PREVENT POSSIBLE AUTOMATIC STARTUP OF ENGINE.	
Check and verify operation of pre-lube pump.	8 hrs
Check and verify operation of keep warm system.	8 hrs
Check and verify operation of starting air compressors or battery charger.	8 hrs
Check and verify starting air pressure is correct or batteries are charged.	8 hrs
Verify that control power is available to the control system and all controls are in the proper position to allow automatic starting of the engines.	8 hrs
Check for fuel oil and lube oil leaks.	8 hrs
Check for cooling leaks.	8 hrs
Check day tank area for leaks.	8 hrs
Check lube oil level; add if required.	week
Inspect air filter; clean/replace if required.	week
Check starting air lubricator; fill if required.	week
Check oil level in governor; add if required.	week
Check coolant level in expansion tank.	week
Record and report any discrepancies.	week

Table 3-2. Diesel engine – operating mode, short term activities

Diesel Engine – Operating Mode, Short Term Activities	
Action	***Frequency***
WARNING! THE MAINTENANCE PROCEDURES OUTLINED IN THIS SECTION MAY OR MAY NOT REQUIRE REMOVING AN ENGINE FROM ITS READY STANDBY STATE SO THAT THE ENGINE DOES NOT AUTOMATICALLY START IF A POWER FAILURE OCCURS. WHEN NECESSARY, OBTAIN CLEARANCE FROM OPERATOR AND VERIFY THAT CONTROLS AND ENGINE STARTING DEVICES ARE PROPERLY LOCKED OUT TO PREVENT POSSIBLE AUTOMATIC STARTUP OF ENGINE.	
Inspect engine and listen for any unusual noise. Check for fuel oil, lube oil, and coolant leaks.	hr
Note and record any excessive vibration in the turbocharger or blower.	hr
Check and record the data indicated on the engine instrument panel. Note any unusual readings and investigate.	hr
Check lube oil level in engine crankcase or sump.	8 hrs
Check coolant level in expansion tank.	8 hrs
Check oil level in governor.	8 hrs
Check fuel strainers for water; drain if required.	8 hrs
Check fuel level in day tank	8 hrs
Check color and smoke level of exhaust gas.	8 hrs
Check lube oil and fuel filter pressure drop; change filters as required.	day
Inspect air filters; replace as required.	day
Check pH of engine coolant; add conditioner as required to meet manufacturer's recommendations.	250 hrs[1]
Take lube oil sample for test and analysis; change lube oil if indicated by test results or provide additives if recommended by lube oil supplier.	250 hrs[1]
Verify proper operation of all safety shutdown controls and alarms; immediately repair any defective items.	1K hrs[2]
Change fuel oil filters; filters should be changed based on maximum recommended pressure differential.	1K hrs[2]

Table 3-2. Diesel engine – operating mode, short term activities (continued)

Diesel Engine – Operating Mode, Short Term Activities	
Action	***Frequency***
Clean and inspect centrifugal lube oil filters if provided.	1K hrs[2]
Grease/lubricate auxiliary pump bearings.	1K hrs[2]

[1]Every Month for Standby Units
[2]Every Six Months for Standby Units

Table 3-3. Diesel engine – operating mode, long term activities

Diesel Engine – Operating Mode, Long Term Activities	
Action	***Frequency***
WARNING! THE MAINTENANCE PROCEDURES OUTLINED IN THIS SECTION MAY OR MAY NOT REQUIRE REMOVING AN ENGINE FROM ITS READY STANDBY STATE SO THAT THE ENGINE DOES NOT AUTOMATICALLY START IF A POWER FAILURE OCCURS. WHEN NECESSARY, OBTAIN CLEARANCE FROM OPERATOR AND VERIFY THAT CONTROLS AND ENGINE STARTING DEVICES ARE PROPERLY LOCKED OUT TO PREVENT POSSIBLE AUTOMATIC STARTUP OF ENGINE.	
Inspect valves and check valve clearance; adjust as required. On two-cycle engines, inspect and clean inlet and exhaust ports.	2K hrs
Check injector timing; adjust as required.	2K hrs
Verify proper operation of all instrumentation.	2K hrs
Inspect blower drive and timing gears if applicable.	2K hrs
Inspect aftercooler; clean if required.	4K hrs
Inspect and clean turbocharger if required.	4K hrs
Change governor oil.	4K hrs
On two-cycle engines, inspect pistons, rings, inlet and exhaust ports, and cylinder liner.	4K hrs
Remove and inspect one cylinder head, piston, liner, and connecting rod. Measure all surfaces subject to wear, and record data for use in determining overhaul intervals. Inspect all oil passages and water side surfaces for obstructions and deposits.	8K hrs
Check foundation bolts for tightness. Where engine and driven equipment are mounted on a skid with spring isolators, inspect spring isolators for proper clearance.	8K hrs
Drain and flush cooling system. Replace coolant. Inspect all thermostatic valves or regulators.	8K hrs
Inspect all engine-driven pumps.	8K hrs
Inspect aftercooler and lube oil cooler; clean if required.	8K hrs
Inspect all gears and/or chain drives for driven components and auxiliaries for wear; adjust if appropriate.	8K hrs
Check alignment of engine and driven equipment.	8K hrs